

# Redberry Juniper Response to Picloram and Top Removal in the Texas Rolling Plains

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## ABSTRACT

Redberry juniper (*Juniperus pinchotii* Sudw.) mortality was evaluated following top removal, picloram application (1, 10, 20%, and 4 cc/3 ft of plant height), and cut-stump treatment with picloram (1, 10, and 20%) on clay flat and shallow redland range sites in the Texas Rolling Plains. The objectives were to determine mortality of redberry juniper following different treatment regimes, and develop sound recommendations for redberry juniper management. Fifty trees were randomly assigned to each treatment. Trees mechanically treated were cut to approximately a 4-inch stump height with a chain saw. Chemically treated trees were sprayed with a basal application of picloram. Trees that received a mechanical and chemical treatment were cut to a stump height of 4 inches and immediately treated with picloram. On the clay flat site, treatments of cut and spray 10 and 20% resulted in 100% mortality, whereas the cut only treatment had the lowest mortality at 7%. Trees in the cut only treatment had the highest number of resprouts, and the cut and spray 1% treatment was the only mechanical and chemical treatment combination that resprouted. The shallow redland site had similar results, with the cut and spray treatments having the highest mortality. Since labor is a major expense in individual plant treatments, spray only treatments are the least expensive treatments when evaluating cost per killed tree. Our results indicate that on both sites, the spray only 10% treatment optimized redberry juniper mortality while minimizing treatment cost. Based on these results, we recommend a basal application of a 10% picloram solution for managing redberry juniper in the Texas Rolling Plains. However, if the management objectives include removing the trees, then we recommend cutting the trees and immediately treating the stumps with a 10% picloram solution.

**KEYWORDS:** cedar, IPT, *Juniperus*, precision application

Redberry juniper is a native multi-stemmed evergreen that naturally occupied rocky, shallow sites in limestone or gypsum soils (Correll and Johnston 1979). Overgrazing, fire suppression, and adaptability of the species have been implicated as the causes for redberry juniper invasion onto grasslands (Steuter and Britton 1983; McPherson and Wright 1990). Redberry juniper ranges from central and west Texas to western Oklahoma, northern New Mexico, central Arizona, and northern Mexico (Correll and Johnston 1979; Ueckert et al. 1994). The 1992 Natural Resource Inventory estimated that redberry juniper occupies about 9 million acres in Texas (Natural Resources Conservation Service 1997).

The ability of redberry juniper to resprout makes control difficult. Redberry juniper is considered an invader on most range sites and has little economic value. However, redberry juniper is desirable on some steep and rocky range sites because it stabilizes the soil and provides wildlife cover (Scifres 1980).

Mechanical, chemical, and pyric control methods have been used to manage redberry juniper (Scifres 1972; Schuster and George 1976; Steuter and Wright 1983; Ueckert and Whisenant 1982). The mortality of seedlings and juvenile trees following treatment is high

compared to adult junipers due to the location of the bud zone above the soil surface (Smith et al. 1975). Although redberry juniper is relatively easy and inexpensive to control as seedlings and juvenile trees, action is not usually taken until trees mature and there is an obvious decrease in herbage production.

Redberry juniper has been noted for its ability to resprout after top removal (Correll and Johnston 1979). This characteristic makes redberry juniper more difficult to control than non-sprouting juniper species such as ashe juniper (*Juniperus ashei* Buchh.) and eastern redcedar (*Juniperus virginiana* L.). Redberry juniper regrowth after cutting was lowest for trees cut in June and highest for trees cut in December, with the amount of regrowth increasing with tree size (Schuster and George 1976). However, McPherson and Wright (1989) reported top removal of redberry juniper resulted in an average mortality of 33% on the High Plains and 19% on the Rolling Plains, but was not impacted by harvest date. Ueckert and Whisenant (1982) reported 100% mortality of redberry juniper seedlings that were hand grubbed 2 to 6 inches deep or cut at the soil surface, regardless of treatment date. Sixteen to 25 months after treatment, none of the seedlings had resprouted.

Picloram (4-amino-3,5,6-trichloro-2-picolinic acid) has proven successful in the management of redberry juniper (Scifres 1972; Schuster 1976; Ueckert and Whisenant 1982). Schuster (1976) reported that individual plant treatments with picloram or picloram plus 2,4,5-T (1:1) effectively controlled redberry juniper when applied as wetting sprays to foliage from April through September. Foliar sprays reduced the canopy by at least 95%, except when sprayed during August and October (Schuster 1976). Schuster (1976) reported that redberry juniper is most susceptible to foliar application of picloram in late spring and in early autumn. Applying 2 lb/acre yielded a 94% canopy reduction and 76% plant kill. Ueckert and Whisenant (1982) reported that pelleted picloram applied in the fall at 2 and 4 lb/acre killed 43 and 44% of the juniper seedlings, respectively. Spring applications of picloram killed 42 and 61%, respectively. Label recommendations for juniper spot treatment is 3 to 4 cc of picloram per 3 ft of plant height. Using a combination treatment, McGinty et al. (2001) reported very high control by treating the cut surface with 4% picloram in water immediately following cutting.

Redberry juniper competes with other vegetation for soil moisture, nutrients, and space, and has little economic and forage value (Taylor et al. 1997). Dense stands inhibit livestock handling and as the canopy cover increases forage production dramatically declines. The objectives of this study were to determine redberry juniper mortality following top removal, picloram application (1, 10, 20%, and 4 cc/3 ft of plant height), and cut-stump treatment with picloram (1, 10, and 20%), and develop practical and sound recommendations for managing redberry juniper with individual plant treatments.

## MATERIALS AND METHODS

This study was conducted in 1996 and 1997 at the Texas Tech Experimental Ranch in Garza County near Justiceburg, Texas on clay flat and shallow redland range sites. The soils on these sites are Dalby clay (fine, mixed, thermic Typic Torrert) and Vernon clay loam (fine, mixed, thermic Typic Ustochrept), respectively (Richardson et al. 1965). Dominant vegetation includes tobosagrass (*Hilaria mutica* [Buckl.] Benth.), alkali sacaton (*Sporobolus airoides* [Torr.] Torr.), blue grama (*Bouteloua gracilis* [H.B.K.] Griffiths), pricklypear (*Opuntia* spp. Mill.), honey mesquite (*Prosopis glandulosa* Torr.) and redberry juniper.

The climate of Garza County is warm, temperate, and subtropical with dry winters and long summers. Average annual precipitation is 20 inches, with maximum precipitation usually occurring in May and June (NOAA 1911 to 1983). The average daily minimum temperature in January is approximately 27° F, and the average daily maximum temperature in July is about 95° F.

This experiment was designed as a completely randomized design with nine treatments on the clay flat site (control, top removal by chain saw, basal application of picloram [1, 10, 20%, and 4 cc/3 ft of plant height], and top removal plus slump treatment with picloram [1, 10, and

20%) and six treatments on the shallow redland site (control, removal by chain saw, basal application of picloram [10 and 20%], and top removal plus stump treatment with picloram [10 and 20%]). Height of treated trees ranged from 3 to 9 ft, with trees less than 3 ft excluded from sampling. Fewer treatments were applied on the shallow redland site due to an insufficient number of trees in the desired height range. Redberry juniper trees on each site were marked and 50 trees randomly assigned to each treatment. The trees mechanically treated were cut to approximately a 4 inch stump height with a chain saw. Chemically treated trees were sprayed with a basal application of picloram following the technique described by Williamson and Parker (1995). Additionally, trees on the clay flat site were treated with 4 cc of picloram/3 ft of plant height following the label recommendation for ashe juniper. Trees mechanically and chemically treated were cut to approximately a 4 inch stump height. Following top removal stumps were immediately treated with picloram using the techniques described by Williamson and Parker (1995). Trees were considered dead if resprouting or green leaf material was absent 15 months post treatment.

All treatments were applied in July 1996 and treatment response was evaluated in mid October 1997. Chi-square analysis was used to assess mortality response to treatments at  $\alpha=0.05$  (Steel and Torrie 1980).

## RESULTS AND DISCUSSION

### Clay flat site

Chi-square analysis on redberry juniper mortality indicated a difference between treatments ( $P<0.05$ ). Two by two contrasts were calculated for all treatment comparisons. The only treatment that was not different from the control was the cut only treatment ( $P=0.2754$ ). The other contrasts with the control were significant ( $P<0.05$ ). A majority of the live trees sustained considerable top-kill 15 months after treatment. The cut only treatment had the lowest mortality at 7%, whereas the cut and spray 10 and 20% had 100% mortality (Table 1). Mortality was greater for the cut and spray treatments than for the spray only treatments. The direct application of picloram to the cut stump likely increased herbicide movement into the roots compared to the basal applications.

The label recommendation of 4 cc/3 ft of plant height had 68% mortality with a 58% canopy reduction of the live stems. Although mortality was not as high as other treatments, the amount of canopy available for photosynthesis was drastically reduced, resulting in trees with a reduced capacity for carbohydrate production. The full impact of this treatment may not occur for several years. A higher mortality would be expected with the label recommendation, but a reduced amount of liquid applied may have contributed to a lower mortality. The other herbicide treatments contained either 80, 90, or 99% water in the solution. A larger amount of liquid applied to the stem bases may have provided a more complete coverage of the base and penetration of the herbicide, and may have reduced the efficacy of the 4 cc/3 ft treatment.

Trees that were mechanically removed in the cut only treatment or a combination of cut and spray responded with resprouts. In the cut only treatment, 93% of the trees resprouted and averaged 109 resprouts per tree. It becomes evident that effective redberry juniper management requires a combination of treatments if the trees are to be mechanically removed above the soil surface. Application of a reduced rate of 1% immediately following top removal resulted in 77% mortality, and only 23% of the trees resprouted (Table 1). The lowest mortality was cut only at 6%, whereas cut and spray 10% and 20% both had mortalities of 100% (Table 1). Increasing the concentration of the spray solution to 10 to 20% applied immediately after cutting resulted in 100% mortality.

### Shallow redland site

Chi-square analysis indicated a difference between treatments ( $P<0.05$ ). As on the clay flat site, the only treatment that was not different from the control was the cut only treatment ( $P=0.0783$ ). The other contrasts with the control were significant ( $P<0.05$ ).

Table 1. Redberry juniper mortality and frequency of resprouts on two range sites in the Texas Rolling Plains following mechanical and/or chemical treatments

Range Site	Treatment	Mortality	Resprout Frequency (%)
Clay Flat			
	Control	2a	1
	Cut Only	7a	93
	Spray Only 1%	60b	0
	Spray Only 10%	84bc	0
	Spray Only 20%	98c	0
	Cut & Spray 1%	77b	23
	Cut & Spray 10%	100c	0
	Cut & Spray 20%	100c	0
	4cc/3 ft	68b	0
Shallow redland			
	Control	0a	1
	Cut Only	6a	94
	Spray Only 10%	88b	0
	Spray Only 20%	88b	0
	Cut & Spray 10%	100b	0
	Cut & Spray 20%	100b	0

1Means within a site followed by the same letter are not significantly different.

There was no difference between spray only 10% and spray only 20% ( $P=0.9653$ ), or cut and spray 10% and cut and spray 20% ( $P=1.0$ ). The treatment with the lowest mortality was cut only at 6%, whereas cut and spray 10% and 20% both had mortalities of 100% (Table 1). The cut only treatment was the only treatment that responded with resprouts, with an average of 94 per tree. The resprout frequency for the cut only treatment was 88%, 1% for control trees, and all other treatments were zero. The two cut and spray treatments had 100% mortality compared to the two spray only treatments at 88%.

Schuster and George (1976) cut redberry juniper trees each month for one year. They found that one year following all treatments 17% of trees had not resprouted. The increased mortality may have resulted from cutting trees at different phenological stages. However, they found that resprouting was least for trees cut in May through August and greatest for trees cut in December. Resprout production of redberry juniper has been reported to increase as tree size increases (Schuster and George 1976). This same pattern was observed on both sites in the current study on cut only trees. Although resprout yield was not quantitatively measured, trees with small stem diameters and one or few stems had considerably fewer resprouts than trees with larger stem diameters and several stems.

## MANAGEMENT IMPLICATIONS

It is economically and environmentally reasonable to use a lower concentration of picloram to manage redberry juniper than the label recommends for ashe juniper. Costs were reduced and mortality increased with spray only treatments on both sites. All of the herbicide-treated trees that did not die had decreased canopy densities, which allows for more light and water to penetrate the canopy and creates an environment more conducive for herbaceous vegetation. The combination of cutting and treating with 10 or 20% picloram was better than the cut only treatment, and was arithmetically higher than the spray only treatments. However, the trade-off for higher mortality in the cut and spray

treatments is increased labor costs. Our results indicate that the spray only 10% treatment optimized redberry juniper mortality while minimizing treatment cost. Based on these results, we recommend a basal application of a 10% picloram solution for managing redberry juniper in the Texas Rolling Plains. However, if the management objectives include removing the trees, then we recommend cutting the trees and immediately treating the stumps with a 10% picloram solution.

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